With the authors Compts

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Inequalities of the lower limbs as to length

by

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"Wight of Brooklyn in 1877 stated
"that nearly every person has actually
a shorter limb on one side than on the other
This conclusion was drawn after a
careful measurement of ~~50~~ 102 males

The left limb is usually the longer

The difference varies from 1/8 to 1 in

In 23 cases equal
– 27 — right limb longer
– 52 — left ———

average difference
1/4 inch.

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Soc of County Kings
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INEQUALITY IN LENGTH OF THE LOWER LIMBS.

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Since Dr Wright of Brooklyn and Dr Cox of New York first pointed out that the lower extremities are very often unsymmetrical in length, this subject has received considerable attention, especially from American surgeons. Dr Hamilton, whose name is well known in connection with fractures, at first doubted the accuracy of the statement, as to the limbs being *generally* of unequal length; but subsequent observations led him and several other surgeons to concur in the opinion. According to their observations the lower limbs of the same individual may vary as much as 300 mm., and the inequality seldom if ever affects the person's gait, being for the most part only observable when the limbs are compared with one another, or measured.

The subject has also received attention in this country, as in the *St Bartholomew's Reports* for 1878 Mr Callender has a paper upon it, in which he gives the measurements of the limbs of twenty-five persons. His experience is, however, contrary to that of American surgeons, as he only found two instances of a-symmetry in length in the twenty-five cases. Although not denying that it sometimes happens, he believes that much more extensive series of measurements are required, before it can be accepted that the limbs are, as a rule, of unequal length. Measurements on the limbs of the living or dead subject are necessarily more or less inaccurate, from the difficulty of obtaining definite points from which to measure, as well as from the measurements being usually made with tapes, which are liable to vary. This is not the case, however, with the bones, as they can be measured tolerably exactly, and the length of the limbs ascertained; but, strange to say, Dr J. C. Roberts of Philadelphia is the only one that, up to this time, as far as I know, has published any observations upon them. Dr Roberts, in a paper published in the *Philadelphia Medical Times* of the 3d August 1878, gives the measurements of eight skeletons. In them he found only one instance where the limbs were equal in length. General conclusions cannot, however, be safely drawn from the measurements of so small a number of skeletons. There being at my disposal a considerable number of complete and well authenticated skeletons in the Museum of the Royal College of Surgeons of England, I thought it desirable to investigate the subject, in order to ascertain whether measurements on the skeleton bore out the observations of American surgeons on the living body, or the contrary, and to suppliment Dr Roberts' measurements. I have taken great pains to ascertain that the bones of each skeleton measured belonged to the same body, and rejected all those that were doubtful, or in which the bones were not perfectly normal and healthy. For assistance in this very important matter, and also for revising and correcting my measurements, I am much indebted to the kindness of Professor Flower, the Conservator of the Museum.

Although apparently easy, it is extremely difficult to measure bones exactly, and great care is required in the selection of a proper measuring apparatus. A uniform plan of measuring must also be adopted. Even after all possible care has been taken, bones will frequently give different measurements, especially if some time has elapsed since the previous measurements have been made. This is often due, as was pointed out by Professor Flower in his lectures last February,[1] to their varying in size according to their state of dryness or the reverse. Measurements of bones taken in winter will be found to differ considerably from those taken in summer, being usually larger in the former case, on account of there being more moisture in the atmosphere in winter than in summer. It is therefore necessary, when making comparative measurements, that the bones be as nearly as possible in the same condition, and in this particular instance, that the measurements of one limb be made at the same time as those of the other. The apparatus I have found most suitable is a flat board, about 80 cm. long by 10 cm. broad, to which a millimetre scale is attached, with two perpendicular uprights of the same breadth as the board, one of which is firmly fixed to the end where the scale begins, the other attached so as to slide backwards and forwards along the board; this latter upright should be made broader at the base than at the top, like a bisected triangle, with the flat surface opposite the other upright, the object of this being to prevent its being displaced backwards from the perpendicular when made to rest against the end of a bone. Altogether, the apparatus is similar to that used by a shoemaker for measuring the foot. The mode of measuring bones I have used, is the one now generally adopted in this country and on the Continent; and one which it is desirable for all who may make observations on this subject in future to adopt, as it would facilitate comparison between the measurements of different observers, as would also the uniform adoption of the metric system. It is done in the following manner:—The bone is laid horizontally upon the measuring apparatus, with its long axis, throughout its whole length, *parallel to the sides of the apparatus*, and with one end resting against the fixed upright, the other upright is slid against the other end, and then the length is read off the scale. In the case of the femur, where the internal condyle is longer than the external, only the former will touch the upright when the axis of the bone is in the proper position. In measuring the tibia I have included the spines and the maleolus. Special care is required to keep the axis of this bone in the right position, as it is liable to become displaced.

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[1] *British Medical Journal*, April 12, 1879, p. 540.

The following table contains the measurements of the skeletons of seventy persons, of various ages, from 12 years and upwards, of various sexes, and of various races of mankind. Owing to the English standard of measurement being inconvenient and troublesome to calculate compared to the metric system, I have adopted the latter.

On examining the table, it will be found that in seven instances only, or in 10 per cent., are the right and left limbs of equal length, and of these there are only two cases in which the femur and tibia of one side corresponds respectively to the femur and tibia of the other. In the remaining five cases, it is by compensation that the limbs are equal; *i.e.*, the tibia being shorter where the femur is longer, or *vice versa*. I may remark in passing, that the table illustrates very clearly the fact that to obtain accurate data from which to draw conclusions our measurements must be as extensive as possible, and that measurements of only

TABLE

Showing the Measurements of the Skeletons of Seventy Persons.

No.	Femur.		Tibia.		Difference in length of limb.		No.	Femur.		Tibia.		Difference in length of limb.	
	R.	L.	R.	L.	R.	L.		R.	L.	R.	L.	R.	L.
	mm.	mm.	mm.	mm.	mm.	mm.		mm.	mm.	mm.	mm.	mm.	mm.
1	422	424	355	355	...	2	36	464	470	398	400	...	8
2	440	440	391	390	1	...	37	397	398	323	324	...	2
3	441	437	358	361	1	...	38	447	449	379	378	...	1
4	417	426	348	346	...	7	39	439	444	378	377	...	4
5	395	397	344	348	...	6	40	375	378	297	296	...	2
6	409	411	347	346	...	1	41	459	455	402	402	4	...
7	367	370	300	299	...	2	42	410	407	346	346	3	...
8	448	447	380	379	2	...	43	432	434	377	381	...	6
9	425	432	342	347	...	12	44	442	439	366	364	5	...
10	425	428	362	362	...	3	45	385	389	324	324	...	4
11	445	443	360	360	2	..	46	364	364	316	314	2	...
12	462	467	389	390	...	6	47	377	379	335	333	equal	equal
13	380	378	338	338	2	...	48	393	391	336	331	7	...
14	356	363	308	312	...	11	49	428	425	378	381	equal	equal
15	419	420	347	347	...	1	50	466	473	397	397	...	7
16	437	439	360	350	8	...	51	447	449	370	370	...	2
17	482	482	382	389	...	7	52	443	449	373	369	...	2
18	625	642	544	538	...	11	53	359	360	304	306	...	3
19	506	507	397	390	6	...	54	404	402	357	355	4	...
20	385	381	300	300	4	...	55	450	453	381	380	...	2
21	479	483	377	378	...	5	56	395	399	314	310	equal	equal
22	447	445	351	352	1	...	57	378	384	312	315	...	9
23	455	452	372	380	...	5	58	380	381	317	316	equal	equal
24	588	589	484	482	1	...	59	392	392	330	330	do.	do.
25	491	500	412	416	...	13	60	413	416	344	348	...	7
26	305	304	241	244	...	2	61	457	457	367	370	...	3
27	477	480	381	387	...	9	62	441	433	354	355	7	...
28	400	397	329	327	5	...	63	492	494	415	412	1	...
29	358	358	303	305	...	2	64	422	422	345	344	1	...
30	393	394	345	342	2	...	65	473	474	417	417	...	1
31	397	400	345	344	...	2	66	469	468	413	410	4	...
32	459	455	303	302	5	...	67	444	447	369	370	...	4
33	390	393	328	328	...	3	68	513	511	427	429	equal	equal
34	382	382	321	319	2	...	69	436	436	368	368	do.	do.
35	384	380	323	323	4	...	70	486	491	411	411	...	5

a few cases are not reliable. It was not till I had measured 47 skeletons that I found one in which the limbs were equal. Had I taken only 50 skeletons, I should have stated the proportion of cases in which the limbs were symmetrical as 4 per cent. instead of 10 per cent. Again, between the 55th and 70th skeleton there are no less than five cases in which the limbs are symmetrical, which, as far as I can judge, would give too high a percentage. In 25 instances, or in 35·8 per cent., the right limb is longer than the left, the average preponderance of the former over the latter in these cases being 3·3 mm. In 38 instances, or in 54·3 per cent., the left is longer than the right, and its average preponderance over the right is 4·8 mm. The left limb, therefore, is not only more frequently longer than the right, but the difference between the limbs is greater on an average, when it is the longer than when the right is the longer, the greatest preponderance of the right limb being 8 mm., whereas that of the left is 13 mm. Over the whole 70 cases, the left limb is $1\frac{1}{2}$ mm. longer than the right.

Analysing the differences still farther, we find that in 41 cases the left femur is longer than the right, in these its average preponderance is 3·8 mm.; in 20 cases the right is longer than the left, in these the average preponderance is 2·9 mm.; and in 9 cases the bones are equal. Again, in 24 cases the left tibia is longer than the right, the average preponderance being 3·0 mm.; in 29 cases the right is longer than the left, the average preponderance being 2·6 mm., and in 17 instances the bones are equal.

The inequalities in the length of the limbs do not, as far as my observations go, seem to be confined to any particular age, sex, or race, as I found that the limbs of young persons differed quite as much as those of many adults. There was the same variety in the limbs of females as males, and of Australians or Negroes as Europeans, &c.

Although much might be learned by comparing results, such as those just given, with the *actual* length of the limbs on living people, we are unable to do so, on account of having to measure the limbs of the latter from the anterior superior spine of the ilium neither the head of the femur nor the upper border of the trochanter major being available for this purpose, the former from being so deeply situated, the latter from its margin being obscured by the insertions of muscles. In order to compare measurements of the extremities from the anterior superior spine of the ilium on the skeleton, with those on the living subject, I tried to measure the distance between the spine and the head of the femur where it rests against the upper border of the acetabulum in the erect posture of the body, on the skeletons, and add it to the length of the limb bones. Being, unfortunately, unable to find a definite point from which to make measurements on the spine, I had, after repeated trials, to abandon the attempt. Had I succeeded, I hoped to have been able to show whether the distance from the spine to the acetabula varied on the two sides of the body in the same way that the bones do, and whether there was any compensation in the pelvic bones, when one limb is longer than the other.

In conclusion, it will be seen that, if we disregard variations or compensation in the iliac bones, my results entirely agree with those obtained by the American observers on living persons. From those facts, and from the fact that other parts of the body are very frequently not symmetrically developed, I think it is extremely unlikely that the lower extremities are generally of the same length in living persons. This circumstance, though probably of comparatively small importance in the treatment of many cases of fractures, must always be kept in mind, as in some cases it may be of consequence. Its importance is, however, considerable in anthropology, and also in Medical Jurisprudence. Indeed, in the latter it has already played an important part in the decision of a case where the medical attendant was prosecuted for maltreatment.[1]

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[1] *American Journal of Med. Science.*